

## NORTH ATLANTIC METEOROLOGY.

[Pressure in inches and millimeters; wind-force by Beaufort scale.]

## NORMAL CONDITIONS.

The normal barometric pressure for June over the North Atlantic Ocean, as deduced from international simultaneous meteorological observations taken at Greenwich noon and not reduced to standard gravity, is highest, 30.20 to 30.25 (767 to 769), over a region stretching between N. 30° to N. 41° and W. 18° to W. 51°; a corresponding region of high pressure exists over the North Pacific Ocean between N. 20° to N. 40° and west of W. 140°. The region of lowest pressure, 29.80 to 29.75 (757 to 755), over the North Atlantic Ocean covers an oval that includes Iceland and southern Greenland and stretches between longitude 0 and W. 75° and N. 60° and N. 70°; in the North Pacific Ocean the lowest pressure, 29.70 (754), includes the southern portion of Kamchatka and stretches between E. 152° and E. 164° and N. 50° to N. 55°. The isobars of the Northern Hemisphere for the month of June show a continued steady diminution in the barometric pressure over North America and Asia, and especially in the Arctic regions, such as to show a strong tendency toward the formation of systems of isobars and winds concentric with the North Atlantic and North Pacific oceans. The meteorological centers lie east of the geographic centers, leaving regions of low pressure extending from the central portions of the North American Continent northward over the polar regions and thence southward into India.

As compared with May the normal pressures for June show no change over a belt extending from Texas to Kansas, and thence eastward over North Carolina to the mid-Atlantic at N. 35°, W. 50°, thence northeast to Great Britain, northward to Greenland, and south-southeast to Sicily. Pressures have fallen 0.20 in the Arctic region between N. 62° at Great Slave Lake, in North America, and N. 76° in Nova Zembla.

The normal zone of maximum frequency of paths of storm centers passes northeastward from northern China to Kamchatka, and thence through the central portions of Bering Sea to Alaska, Stikine, and British Columbia. Up to this point the number of storm centers, per month of June per quadrilateral of 5°, has diminished from 1.5 in the China Sea to 0.4 in British Columbia, but it now begins to rapidly increase as the path of maximum frequency moves due eastward from Oregon to Newfoundland, and reaches its maximum, 3.2, on Lake Superior, after which it diminishes as the path proceeds toward Scotland, where the frequency is about 1.8. This variation in the frequency of storm centers, along the path of maximum frequency, is not to be attributed to any great variation in the number of cyclonic centers, but, first of all, to their feebleness during the month of June, by reason of which many of them are broken up and perhaps fail to be counted, and second, especially to the fact that the directions of motion are erratic. In general, the larger disturbances that we recognize as cyclonic systems on the daily weather map are initiated by the overflow and descent polewards of the upper colder air from the high regions ordinarily called tropical highs; but they do not develop unless the cold, dry air thus descending is sufficient in quantity to elevate the surface stratum which it underruns sufficiently to form abundant cloud and rain, and this condition is not likely to be fulfilled in the month of June, when the solar heat is still occupied in melting the snow, ice, and frozen ground of the Arctic regions.

The normal rate of progress of storm centers during June is 25 miles per hour in the United States, 16 miles over the Atlantic, 18 in Europe, 23 over the seas of China and Japan, 26 in the Bering Sea, and 20 in the Pacific Ocean between the Alaska peninsula and the coast of Oregon. The average

motion easterly is 21 miles per hour. Of those tropical storms that move westward in the regions of the West Indies and Phillipine Islands before re-curving to the north and east the average movement westward is also 21 miles per hour.

## NORTH ATLANTIC STORMS.

The following paragraphs give some account of the areas of low pressure and strong winds on the North Atlantic Ocean during June, 1894. Daily charts are compiled at the Weather Bureau showing the atmospheric conditions over the United States, Europe, and the Atlantic Ocean, as nearly as practicable at Greenwich noon, and afford a basis for approximating the locations and paths of the more important areas of high and low pressure.

A. This was a continuation of *K* of the North Atlantic series for May; it was central on the 1st, at N. 51°, W. 23°, while a minor depression was then central near the south coast of Ireland. By the 2d, noon, the latter depression had moved northward and increased in intensity while the former was dying out. By the 3d, noon, only a feeble trace of *A* was left at about N. 50° and W. 20°. By the 4th, noon, the minor depression had disappeared, as it passed northward over Scotland, and *A* had again grown into importance, being central at N. 49°, W. 11°. On the 5th, noon, *A* was central in the Irish Sea, at about W. 7°, N. 53°, at which time a series of depressions extended northeastward, respectively over the North Sea and the Gulf of Finland, with rather high pressures to the north and south.

B. This is area No. II, of the U. S. series, and was central in the St. Lawrence Valley on the 1st. After retreating as it were to the northward and moving slowly east it passed over Labrador on the 4th and was central on the 5th near the Straits of Belle Isle. Pressure continued high over the Atlantic to the southward, and *B* kept to the north of our reports. On the 6th it was central near N. 56°, W. 40°, and on the 8th, N. 55°, W. 23°, while a more severe cyclonic storm had developed to the westward. On the 9th *B* was central over the Irish Sea, and on the 10th and 11th it merged into the general trough that extended from Great Britain eastward into Russia, out of which there developed a general cyclonic storm that was central on the 12th over the southern Baltic, and from the 13th to the 16th passed southeastward over Russia to the Caspian Sea. A depression which thus expands or contracts and changes from a feeble circulation to an important storm with every alternation in the nature of the region over which it passes, and the inflowing air that feeds it, may be considered as mechanically the same cyclonic whirl, although some will regard the storms into which it develops from time to time as separate storms. There is in fact data to show that similar depressions in their progress from Europe eastward sometimes, eventually, affect the climate of India and bring to that region the conditions that favor the renewed initiation of a storm center.

C. This appeared on the 6th at the mouth of the St. Lawrence, and by the 7th, noon, apparently united with a depression that had formed off the middle Atlantic coast. By the 8th, noon, there was a well-marked storm center over Newfoundland, and reports of high gales were received from the steamships *Pomeranian* (2 p. m., N. 48° 14', W. 49° 00', 29.37, NW., 8), *Peruvian* (noon, N. 48° 14', W. 48° 52', 29.32, NNW., 8), *Hungaria* (6 a. m., N. 47° 08', W. 22° 42', 29.85, NW., 9), *Wandrahm* (4 a. m., N. 47° 00', W. 59° 00', 29.28, NW., 8), *Habana* (midnight, N. 53° 00', W. 37° 00', 29.38, WSW., 10). By the 9th, noon, *C* had moved northeastward toward Iceland and beyond our reports, but on the 10th, noon, a depression,

with occasional gales, was midway between Iceland and Ireland and undoubtedly represents the region occupied by C.

D. This appeared on the 9th at the mouth of the St. Lawrence, moved slowly east-northeast, and disappeared on the 13th south of Iceland. The areas B, C, and D, represent whirls inside of the general depression that extended over British America and the North Atlantic Ocean from the 5th to the 13th, and gradually advanced eastward, filling up at its western extremity more rapidly than at its eastern.

E. On the 13th this depression appeared, central at N. 37°, W. 55°, in connection with a feeble cyclonic system and about 1,500 miles southeast of the center of D. By the 14th, noon, pressure had fallen at the Bermudas, but risen decidedly over Nova Scotia, and the central depression was at about N. 38°, W. 51°. It now moved rapidly northeastward and seems to have joined with another depression, the combined result forming on the 15th a V-shaped depression at about N. 51°, W. 38°. This passed eastward on the 16th, lingered near Scotland on the 17th and 18th, while the general low pressure extended eastward over Europe and westward over British America. This condition continued until the 24th, the barometer being relatively high over southern Europe and westward to Florida, but low over the Atlantic north of N. 50°. This is the normal or typical condition of the general circulation of the atmosphere at this season. Several special depressions appeared in the general area of low pressure moving eastward from the Rocky Mountain slope in conformity with the general circulation of the air, but not developing into cyclonic storms, and lowest pressure generally remained south of Iceland. The principal exception to this statement was the following area.

F. This passed over the mouth of the St. Lawrence on the 22d, noon, and by the 24th, noon, was central at about N. 45°, W. 49°, at the southern apex of a V-shaped depression. On the 25th, noon, it was central at N. 50°, W. 33°; 26th, noon, N. 34°, W. 30°. By the 27th, noon, it had entirely disappeared and an area of high pressure had pushed east over the middle Atlantic and north over western Europe, so that by the 27th the pressure of 30.50 prevailed from the Bermudas eastward, as also over the extreme north of Scotland. Between these areas of high pressure the low pressure F seems to have tarried until the 30th, when it was central at about N. 47°, W. 23°.

#### LOW PRESSURES IN THE CARIBBEAN SEA.

The equatorial belt of low pressure extending from the Pacific eastward over Central America into the Caribbean Sea has, during the current month, several times seemed about to give rise to a cyclonic storm. The northeast trade of the Caribbean Sea is delicately balanced against the southeast to southwest winds on the Pacific side of this portion of the continent, and the mountainous ridges serve as the barrier between them; under these circumstances a comparatively slight barometric depression suffices to initiate a severe local storm, and several such seem to have occurred during the month. On the 13th a gale was reported at Panama. On the 18th Mr. Rafael Inguera, the observer at Santiago de Cuba, reported that the weather has been very wet and rainy throughout the island this season; the barometer has been in a continual fluctuation; the cirri and cirrocumuli in the upper strata of the atmosphere have made an unusually early appearance; the movements of these clouds are from the SSE., the S., and the SSW., and the rainy weather sets in, with winds from these same directions; the last period of rainy and stormy weather traversed the island on the 4th, 5th, and 6th of June, causing heavy rain and floods and much damage on the south side of the island. Mr. Inguera considers that these phenomena, especially the appearance of the cirrus clouds, may indicate that there will be early hurricanes this autumn.

On the 23d the same observer at Santiago reported that "the barometer rises and falls continuously; cirrus clouds are moving from S.  $\frac{1}{2}$  SE., SSE., SE.  $\frac{1}{2}$  S.; the weather is becoming very hot and sultry; heavy seas from ESE. to S.; there is no doubt that a hurricane depression exists in the South Sea." The weather map shows that at this time, and indeed from the 19th to the 25th, pressure had been quite high at the Bermudas (30.45) and about average (29.95) in Panama and Costa Rica, so that a steady northeast wind prevailed over the West Indies and Caribbean Sea during the first part of this period, gradually veering to southeast during the latter part. As the cirrus clouds at Santiago usually come from the southwest and west it follows that either the south and southeast cirri observed by Inguera were unusually low, or else, which is more likely, that the lower atmosphere moving from the northeast was unusually deep, so that the cirri were formed in the region of overflowing southerly currents and did not reach up into the region of southwest currents.

#### OCEAN ICE IN JUNE, 1894.

The following table shows the southern and eastern limits of the regions within which icebergs or field ice were reported for June during the last 12 years:

Southern limit.			Eastern limit.		
Month.	Lat. N.	Long. W.	Month.	Lat. N.	Long. W.
June, 1883.....	40 28	51 45	June, 1883.....	48 14	42 43
June, 1884.....	41 42	47 49	June, 1884.....	44 00	45 23
June, 1885.....	39 38	48 12	June, 1885.....	45 14	41 12
June, 1886.....	40 30	53 00	June, 1886.....	49 15	40 00
June, 1887.....	40 40	48 34	June, 1887.....	43 22	39 19
June, 1888.....	43 38	43 24	June, 1888.....	43 38	43 24
June, 1889.....	42 54	49 54	June, 1889.....	46 57	40 29
June, 1890.....	40 01	52 00	June, 1890.....	46 08	37 07
June, 1891.....	40 15	50 24	June, 1891.....	44 15	43 47
June, 1892.....	41 44	50 40	June, 1892.....	45 50	40 46
June, 1893.....	42 08	53 19	June, 1893.....	47 20	44 19
June, 1894.....	40 10	57 30	June, 1894.....	49 20	36 30
Mean.....	41 09	50 33	Mean.....	46 08	41 16

\* On the 10th a small block of ice was reported in N. 46° 28', W. 28° 34'.

The limits of the region within which icebergs or field ice were reported for June, 1894, are shown on Chart I by crosses. The southernmost ice reported, an ice floe about 70 feet square, observed on the 21st in the position given, was about one degree south of the average southern limit, and the easternmost ice reported, one large berg and a quantity of field ice on the 25th in the position given, was about four and three-fourth degrees east of the average eastern limit.

#### OCEAN FOG FOR JUNE, 1894.

The limits of fog belts west of the fortieth meridian, as reported by shipmasters, are shown on Chart I by dotted shading. East of the fifty-fifth meridian fog was reported on 22 dates; between the fifty-fifth and sixty-fifth meridians on 24 dates; and west of the sixty-fifth meridian on 16 dates. Compared with the corresponding month of the last six years, the dates of occurrence of fog east of the fifty-fifth meridian numbered 11 more than the average; between the fifty-fifth and sixty-fifth meridians, 11 more than the average; and west of the sixty-fifth meridian, 1 more than the average.

28th.—During a dense fog a schooner went ashore at Grand Manan Island.

29th.—During a dense fog a schooner went ashore at Campbell Island, N. B.

#### WATERSPOUTS.

Waterspouts have been reported on the following dates:

3d.—*Key West, Fla.*—The forenoon was clear, midday was partly cloudy; wind increased from light to fresh and veered from northwest to northeast; light showers from 3.10 to 3.50; no decided change in temperature; pressure increased steadily.

Two large waterspouts were observed at about 3 p. m. a short distance to the northeast; cloudiness increased between 5 and 6, followed by a thunderstorm moving from east to west.

17th.—*New Orleans, La.*—At 12.55 distant thunder was heard; loudest at 1.14 p. m.; last heard at 2.10 p. m.; storm moved from the southeast to the northwest; direction of wind before the storm, southeast; after the storm, south; temperature before the storm, 90; after the storm, 73; rain began at 1.05 p. m. and ended at 1.40 p. m. About 1.30 p. m., on Lake Pontchartrain, 5 miles from the city, a waterspout was observed. The wind previously had been light and died away to a calm. Dark and threatening clouds spread over the lake and several bright flashes of lightning were seen. The first evidence of the waterspout was a mass of spray whirling in a large circle, which soon increased in rapidity; then a thin, long line of white vapor was observed to descend from the darkest cloud, and as it neared the surface of the lake the mass of spray whirled faster. As the waterspout passed the

club house a loud roaring noise was heard. The waterspout passed up the lake and slowly dissolved.

18th.—*Fort Morgan, Ala.*—Weather squally and showery all the early morning. Rain in northwest from about 6 to 7 a. m. At 6 a. m. a large waterspout formed outside, about 5 miles off the shore, moving toward south-southwest and seemed to be a solid connection with the gulf for about 25 or 30 minutes; 8 a. m. light sprinkle of rain here; squalls all around; raining very hard in bay and gulf, with thunderstorms.

24th.—*Oak Hill Post-office, Mosquito Lagoon, Volusia Co., Fla.*—Temperature of the air, 80; wind south; a small waterspout was seen on the lagoon, 2½ miles distant, in which the spiral motion was plainly visible with a field glass. 27th, temperature about 84, wind southeast; a waterspout of large dimensions was observed on the ocean near the horizon; it had a funnel shape, but was too far distant to observe the spiral motion. The first one seen was straight like a ribbon.

### TEMPERATURE OF THE AIR.

[In degrees Fahrenheit.]

The distribution of the monthly mean temperature of the air over the United States and Canada is shown by the dotted isotherms on Chart II; the lines are drawn over the high irregular surface of the Rocky Mountain plateau, although the temperatures have not been reduced to sea level, and the isotherms, therefore, relate to the average surface of the country occupied by our observers; such isotherms are controlled largely by the local topography, and should be drawn and studied in connection with a contour map.

#### NORMAL TEMPERATURE.

In Table II, for voluntary observers, the mean temperature is given for each station, but in Table I, for the regular stations of the Weather Bureau, both the mean temperatures and the departures from the normal are given for the current month. In the latter table the stations are grouped by geographical districts, for each of which is given the average temperature and departure from the normal; the normal for any district or station may be found by adding the departures to the current average when the latter is below the normal and by subtracting when it is above.

#### MONTHLY MEAN TEMPERATURE.

For the regular stations of the Weather Bureau the monthly mean temperature is the simple mean of all the daily maxima and minima; for voluntary stations a variety of methods of computation is necessarily allowed, as shown by the notes appended to Table II.

During June, 1894, the highest mean temperatures were: Yuma and Corpus Christi, 79.4; Brownsville, 82.0; Key West, 80.0.

The lowest mean temperatures were: Eastport, 52.6; Point Reyes Light, 52.2; Tatoosh Island, 53.0; Eureka, 54.4; and at Canadian Stations: Anticosti, 51.8; Edmonton, 58.4.

#### DEPARTURES FROM NORMAL TEMPERATURE FOR JUNE, 1894.

As compared with the normal for June the temperatures for the current month were decidedly in excess in the Lake region, the Dakotas, the Mississippi and Missouri valleys; but were deficient in the south Atlantic and Gulf States, the entire plateau region, and Pacific States. The greatest excesses were: 7.1, St. Vincent; 7.3, Winnipeg; 5.4, Moorhead; 4.9, Duluth and St. Paul; 5.8, Marquette; 5.6, Green Bay; 6.1, Milwaukee. The largest deficits were: 5.4, Yuma; 5.3, Tucson; 4.4, Los Angeles; 5.0, Winnemucca; 5.2, Red Bluff; 4.5, Portland, Oreg.

The departures from normal temperature for the current month, by districts, are as follows:

Positive departures: New England, 1.0; middle Atlantic coast, 1.0; Ohio Valley and Tennessee, 1.7; lower Lake region, 2.9; upper Lake region, 5.1; North Dakota, 5.4; upper Mississippi, 4.5; Missouri Valley, 2.4; northern slope, 0.2.

Negative departures: South Atlantic coast, 0.7; Key West, 2.7; east Gulf States, 1.1; west Gulf States, 1.4; middle slope, 0.4; southern slope (Abilene), 0.5; southern plateau, 3.6; middle plateau, 4.4; northern plateau, 2.5; north Pacific coast, 1.2; middle Pacific, 3.5; south Pacific coast, 4.0.

The following table shows for certain stations, as reported by voluntary observers, the normal and extreme mean temperatures for this month:

State and station.	(1) Normal for the month of June.	(2) Length of record.	(3) Mean for June, 1894.	(4) Departure from normal.	(5) Extreme monthly means for June.			
					Highest.	Year.	Lowest.	Year.
<i>Arizona.</i>	°	Years	°	°	°		°	
Fort Apache .....	71.5	22	65.1	— 6.4	78.0	1876	63.6	1884
Whipple Barracks .....	69.4	23	61.6	— 7.8	78.9	1876	61.6	1894
<i>Arkansas.</i>								
Keesees Ferry .....	76.9	12	74.7	— 2.2	80.2	1885	73.8	1893
<i>California.</i>								
Riverside .....	71.0	12	63.8	— 7.2	78.1	1883	63.8	1894
<i>Colorado.</i>								
Las Animas .....	69.9	11	68.2	— 1.7	72.5	1887	68.1	1884
<i>Florida.</i>								
Merritts Island .....	78.7	12	79.1	+ 0.4	83.4	1890	73.8	1892
<i>Georgia.</i>								
Forayth .....	76.9	20	80.5	+ 3.6	81.9	1880, 1881	74.2	1884
<i>Idaho.</i>								
Boise Barracks .....	66.3	20	61.7	— 4.6	74.3	1871	60.0	1891
Fort Sherman .....	60.6	11	.....	.....	64.4	1882	55.0	1893
<i>Indiana.</i>								
Lafayette .....	70.6	12	72.7	+ 2.1	75.7	1890	66.2	1889
<i>Iowa.</i>								
Cresco .....	66.1	21	69.4	+ 3.3	72.0	1873	62.8	1877
<i>Kansas.</i>								
Eureka Ranch .....	75.5	11	74.3	— 1.2	80.0	1890	70.8	1892
Independence .....	74.8	22	78.1	+ 3.3	79.0	1872	70.8	1889
Salina .....	75.3	10	75.9	+ 0.6	79.3	1890	71.2	1891
<i>Louisiana.</i>								
Grand Coteau .....	79.6	11	77.5	— 2.1	82.0	1891	77.5	1894
<i>Maine.</i>								
Orono .....	62.1	23	60.9	— 1.2	64.8	1884, 1889	57.5	1881
<i>Maryland.</i>								
Cumberland .....	68.9	23	72.2	+ 3.3	74.0	1874	65.3	1878
<i>Michigan.</i>								
Kalamazoo .....	67.6	17	70.8	+ 3.2	70.8	1894	63.7	1889
<i>Missouri.</i>								
Sedalia .....	74.3	12	77.2	+ 2.9	80.5	1890	71.6	1891
<i>Montana.</i>								
Fort Custer .....	63.8	12	67.1	+ 3.3	67.1	1834	60.8	1891
<i>Nebraska.</i>								
Fort Robinson .....	67.1	9	67.0	— 0.1	71.7	1887	62.5	1891
Genoa (near) .....	69.6	18	73.7	+ 4.1	73.7	1894	66.4	1877